NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

September 21, 2020

Video Study

Specialist's Factual Report
By Sean Payne

1. EVENT SUMMARY

Location:	Northlake, Illinois
Date:	April 23, 2020
Company:	Union Pacific
Train ID:	YPR604
NTSB Number:	RRD20LR003
Summary:	Refer to the Accident Summary report, within this docket.

2. DETAILS OF RECORDER INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following security camera file:

Device:	**Bosch AutoDome PTZ**
Camera Name:	**"Yard Nine Cam 1"**

2.1. Video Device Description

The Bosch Autodome series is a product line of security-oriented IP (internet protocol) cameras. The specifications of the relevant device are dependent on how the system hardware and software is configured. The system involved in this accident utilized PTZ (pan tilt zoom) cameras which allow the system operator to control the orientation of attached cameras.

2.2. Video Recording Description

Two files were transmitted to the NTSB Vehicle Recorder Lab. One file was an export using the security camera system's software and was 320 by 240 pixels in resolution at a frame rate of 30 frames per second (fps).[1] The other file was a screen capture of the security camera system's playback display. This screen capture was recorded at a resolution of 1668 x 974 pixels and at a frame rate of 9.75 fps. The encoding and decoding algorithm, or codec, for the files was H.264, also referred to as MPEG-4 Advanced Video Coding (AVC) part 10. It was determined that the security camera system's export software degraded the quality of the recording, and the screen capture of the display was

[1] This security camera's playback system internal software exported the video file at a lower resolution than could be captured by a screen capture program.

utilized. All images in this report are from the screen capture of the security camera system's display.

H.264 is typically used for lossy compression, meaning that the encoding algorithm uses approximations and partial data discarding to represent the content to reduce data size. The end result is composed of various types of frames and/or slices called I frames/slices, P frames/slices, and B frames/slices, where frames are the complete image and slices are a region of the frame separately encoded from other regions of the same frame. I-frames (intra-coded picture) represent the complete image, P-frames (predicted picture) contain changes in the image from the previous frame, and B-frames (Bidirectional predicted picture) use changes between the current frame and both preceding and following frames.

2.3. Time Correlation

The security camera system displayed time in the format HH:MM:SS.000, where HH stands for the number of hours, MM the number of minutes and SS.000 the number of seconds to three decimal places. The recorded time was in general agreement with the noted accident time and was assumed to be correct. All times used in this report reference the recorded security camera system time and are given in Central Daylight Time (CDT).

2.4. Security Camera Images

All frames from the screen capture of the security video recording were exported in a lossless format. In addition to the security camera system's timestamp, an independent time code was added to the exported frames, however, all timestamps in this report refer to the original security camera system's timestamps.

The Investigator-In-Charge (IIC) requested to examine the following:

1) If the RCL (Remote Control Locomotive) Operator on the rear of the train made a hand signal prior to impact to the truck.

2) If there was a hand signal by the RCL Operator, the time between making the hand signal and impact.

3) If the brake lights activated on the vehicle that was struck.

4) If the brake lights were activated, the time the brake lights activated on the vehicle that was struck.

1) Hand Signal from RCL Operator

An examination of exported lossless frames showed a change of a group of pixels in the vicinity pf the RCL Operators shoulder at 10:02:21.773, however, at this time the area of the operator's left shoulder was passing in front of an area of varying contrast in the roadbed next to the track. It is possible that the H.264 codec of the video resulted in visual

compression artifacts due to the way the filesystem encodes video. Figure 1 is a redacted screen capture of the frame at this moment at 10:02:21.773.

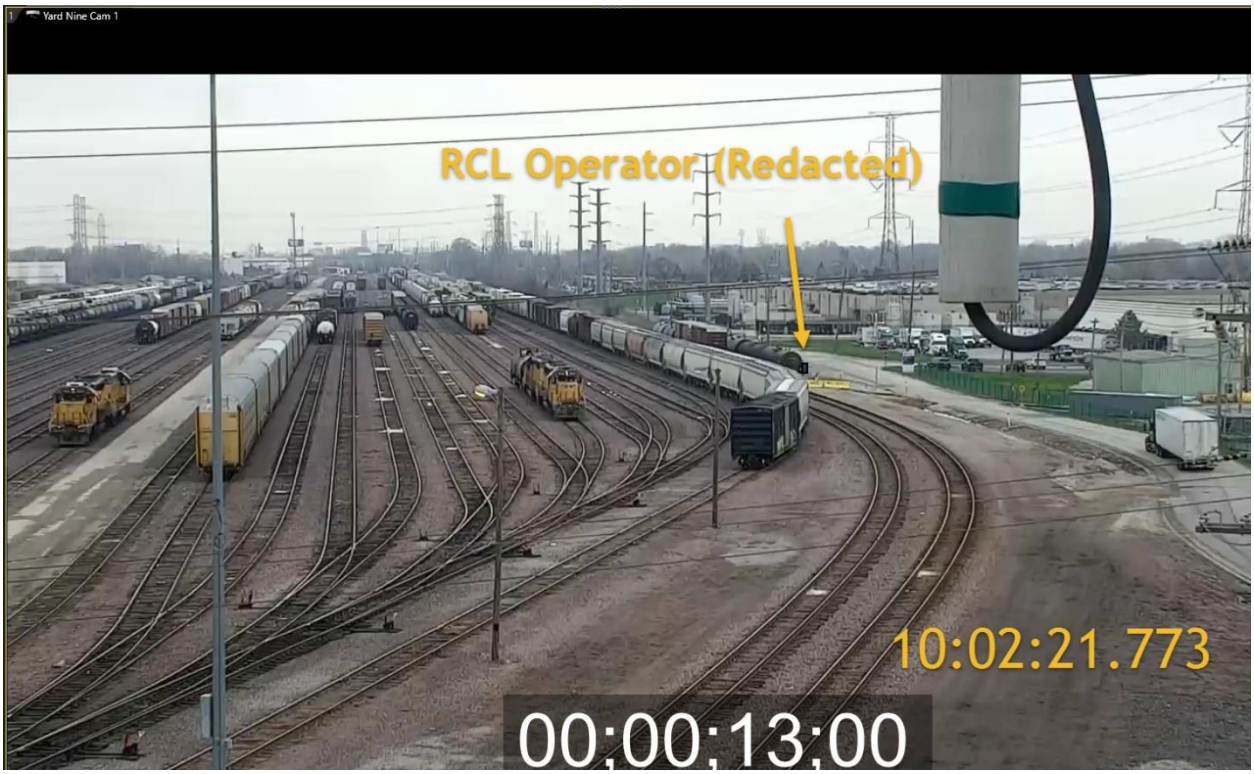

Figure 1. A redacted security camera frame at 10:02:21.773.

Moving forward in time, at 10:02:24.683, there is a conclusive change in the pixel density in the vicinity of the operator's left shoulder. At this time, there was no change in coloration of the roadbed next to the track (background behind the operator) and it is unlikely that visual compression artifacts were present around the RCL Operator's shoulder. Figure 2 is a redacted screen capture of the frame at this moment at 10:02:24.683.

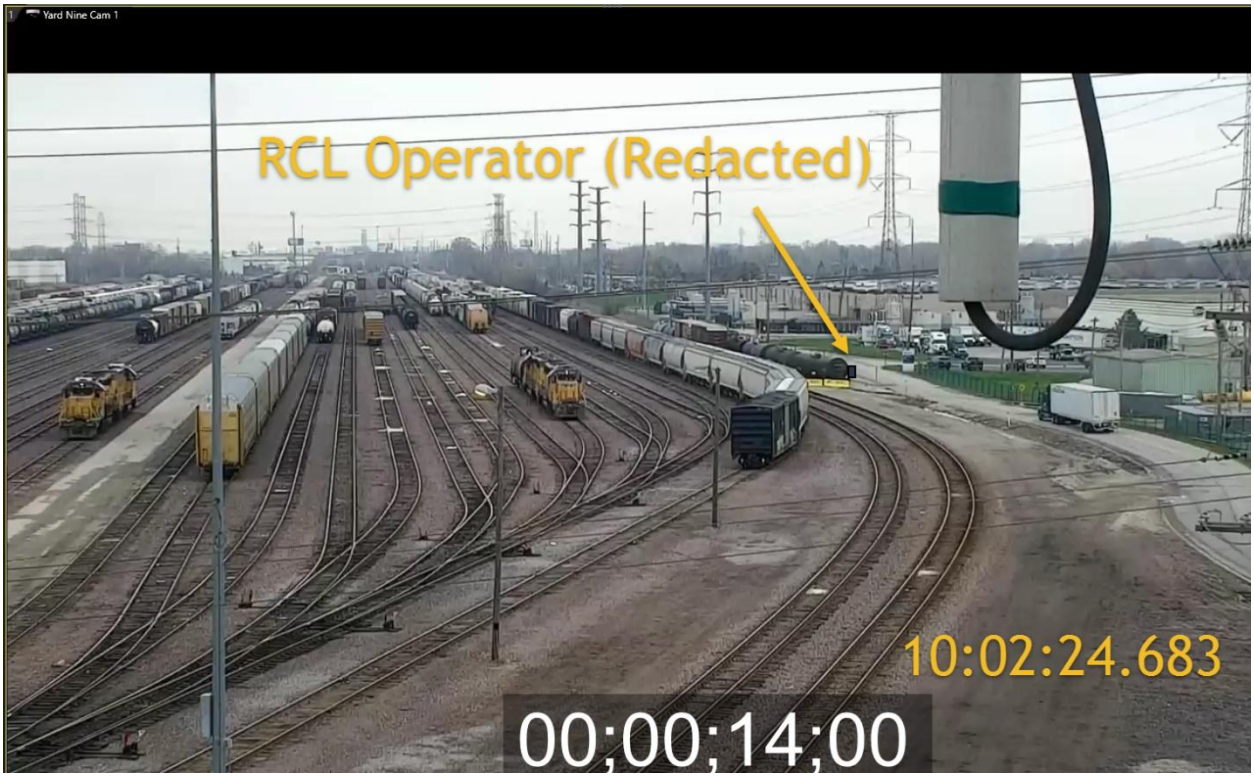

Figure 2. A redacted security camera frame at 10:02:24.683.

Between 10:02:24.683 and impact, which appeared to occur at 10:02:28.703, the pixel density in the vicinity of the RCL Operator's left shoulder changed repeatedly. At this time, there was no change in coloration of the roadbed next to the track (background behind the operator) and it is unlikely that visual compression artifacts were present around the RCL Operator's shoulder. This could indicate that the RCL Operator was making a movement of his left arm.

Continuing images showed that Impact occurred at 10:02:28.703. Figure 3 is a redacted screen capture of the frame at this moment.

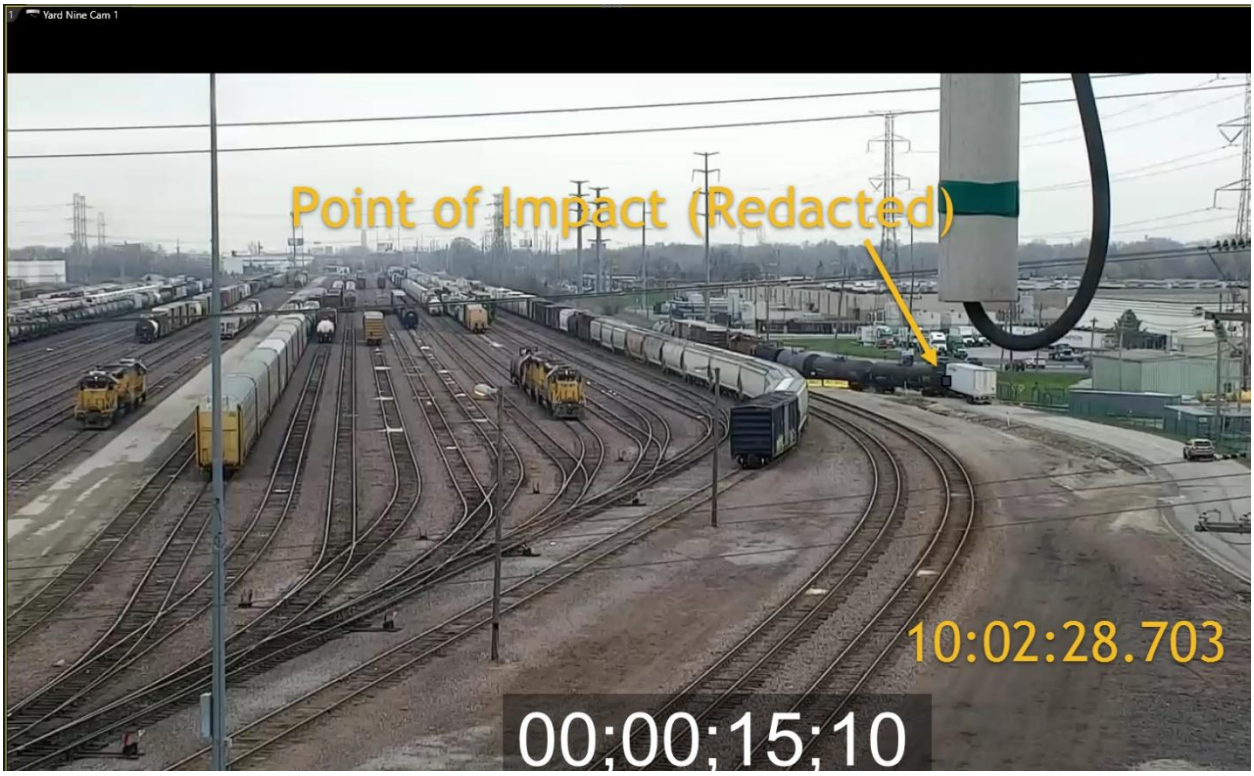

Figure 3. A redacted security camera frame at 10:02:28.703.

2) Time Between Hand Signal and Impact

If the change in pixel density in the vicinity of the RCL Operator's shoulder is assumed to be a hand signal at 10:02:21.773, then the time between the first potential hand signal and impact was 6.93 seconds.

The time between the second conclusive hand signal at 10:02:24.683 and impact was 4.02 seconds.

3) Brake Light Activation on the Struck Vehicle

Exported frames were examined in the vicinity of the struck vehicle trailer's rear end. No obvious change in pixel brightness or color was detected in this region either prior, during or after the impact sequence. Just following the impact, a trailing vehicle (a late model SUV) came to a stop behind the impacted vehicle. As the late model SUV came to a stop, no light emitted from the late model SUV's taillights were detected. Additionally, at the time the impacted vehicle came to a stop, a measurement was taken of the rear width of the trailer in pixels. This measurement was 25 pixels. The width of a standard 53 foot trailer is 102 inches. This means that each pixel represents approximately 4 inches per pixel. At this resolution, including the consideration of H.264 encoding errors and the daytime lighting conditions that were present, it is unlikely that brake light activation could be detected.

A determination of trailer light activation by the struck vehicle was not able to be determined.

4) Time Between Brake Light Activation and Impact

A determination of trailer light activation by the struck vehicle was not able to be determined, and therefore a time delta between activation and impact was unable to be determined.